

1    Color-fast Stretch Material and Method of Making Same

2    Background of the Invention

3    (1) Field of the Invention

4       The present invention relates generally to textile materials and, more particularly, to a  
5       color-fast stretch material and method of making it.

6    (2) Description of the Prior Art

7       Typically, prior art textile materials or fabrics are produced by a variety of  
8       manufacturing methods, including but not limited to knitting, weaving, nonwovens  
9       manufacturing, and are further processed based upon intended end uses, including but not  
10      limited to coloring the fabric to a desired color and shade.

11      U.S.Pat. No. 6,068,666 to Amick, et al. discloses a blended fiber garment over  
12      dyeing process wherein garments are dyed in a two-stage process to yield outstanding  
13      colorfastness, pilling resistance, dimensional stability and durability. More particularly,  
14      Amick teaches dyeing the cellulosic fiber portion of the garments, and dyeing the  
15      synthetic polymeric fiber portion of the garments at temperatures and pressures above  
16      atmospheric conditions.

17      U.S.Pat No.,6,308,535 to Sangiacomo teaches a method for the manufacture of  
18      designed knitwear on circular stocking knitting and knitting machines is provided using  
19      one or more feed stations, starting from a first base yarn and from a second base yarn for  
20      the manufacture of a basic knit fabric and from at least one dyed yarn to create a design  
21      in the basic knit fabric. By way of contrast the present invention is not directed as  
22      mutliple yarn components dyed separately in order to produce a noticeable pattern in the  
23      finished fabric.

1           Prior art coloring methods commonly employ either dyeing yarns prior to fabric  
2           formation and/or to dyeing finished fabric or garments. However, where a stretch  
3           component is included in the fabric, the dyeing processes and parameters that are suitable  
4           to a similar fabric not having a stretch component may not be appropriate in order to  
5           realize the same finished coloration for the stretch-component fabric as for that of the  
6           fabric without it. More particularly, stretch components such as LYCRA cannot be  
7           processed at the same temperatures for coloration processing as for certain synthetic  
8           components such as polyethylene terephthalate (PET) polyester which may require  
9           disperse dyestuffs applied at as high as 260 degrees Fahrenheit under pressure, as these  
10          temperatures typically degrade the performance properties of the stretch component,  
11          thereby having a negative impact on the properties of the finished fabric or garment.  
12          However, without fabric- or garment-dyeing color uniformity is not ensured in the  
13          finished fabric or garment; in particular, noticeable differences between the stretch  
14          component and non-stretch components provide objectionable non-uniformity in the  
15          finished fabric or garment that is readily noticeable to the end user or consumer during  
16          product use, especially in garments having high stretch when worn. Unfortunately,  
17          processing the fabric or garment at lower temperatures so as not to degrade or diminish  
18          the performance properties of the stretch component in the finished product typically  
19          produces a non-color-fast material, wherein fading occurs over time due to cleaning and  
20          wear, and color non-uniformity can also result, even before use.

21           Solution dyeing has also been known in the prior art for yarn dyeing. However,  
22           the applications known have not addressed the problems in dealing with multiple yarn  
23           types for the fabric constructions and applications set forth hereinabove.

1           Thus, there remains a need for a color-fast stretch material having uniform color  
2     properties while maintaining the optimal performance properties of the stretch component  
3     within the material.

4     Summary of the Invention

5           The present invention is directed to a color-fast material having a combination of  
6     stretch and non-stretch components therein.

7           In the preferred embodiment, the color-fast material may be manufactured as a  
8     knit, woven, non-woven, or other fabrication method for producing a fabric, wherein the  
9     fabric is formed of at least two yarn types, a first component having significant stretch or  
10    elastomeric properties and a second component having substantially lower stretch or  
11    elastomeric properties than the first component, and wherein the fabric is dyed after  
12    fabric formation at temperatures suitable to ensure color-fastness in both the first and  
13    second components without significantly degrading the properties of either component.  
14    Preferably, the second component is a synthetic yarn.

15          The present invention is further directed to a method for manufacturing the color-  
16    fast material having said properties and components.

17          It is an object of the present invention to provide warp knitted and weft knitted  
18    fabrics with better locked-in color consistency from lot to lot through manufacturing and  
19    the life of the garment than standard commercial state of the art fabrics previously  
20    available in the marketplace.

21          It is another object of the present invention to provide stretch knitted fabrics  
22    engineered for performance specifications using special yarn, fabric construction, and  
23    manufacturing process with minimal variation between lots.

1           It is yet another object of the present invention to provide fabric engineered for  
2 specific end-use garment applications while providing superior performance and garment  
3 care cleaning properties.

4           It is still another object of the present invention to provide a method of making  
5 fabrics with a process that essentially eliminates normal textile related variables while  
6 simultaneously accomplishes the specification fabric manufacturing in a minimum  
7 number of steps.

8           It is further an object of the present invention to disclose a process and method of  
9 making stretch or non-elastic fabrics that avoid using environmentally unfriendly  
10 dyestuffs and chemicals , and simultaneously requires much less energy consumption  
11 within the process than standard state of the art fabric making commercial practices.

12           It is also an object of the present invention to provide specification knitted fabrics  
13 containing such unique performance properties as anti-bacterial, hydrophylic and/or  
14 hydrophobic moisture maintenance functions and/or systems, and quick drying  
15 properties.

16           Thus, the present invention provides a color-fast material having a combination of  
17 stretch and substantially non-stretch or non-elastomeric components therein wherein the  
18 material coloration is substantially uniform in both stretched and relaxed states.

19           Accordingly, one aspect of the present invention is to provide a color-fast material  
20 having a combination of a first component with substantial stretch properties and a  
21 second component with substantially lower stretch properties than those of the first  
22 component wherein the material is a fabric manufactured by knitting, weaving, non-  
23 woven or other fabric manufacturing process and the material is dyed prior to fabric

1 formation for providing a material having a color-fastness and color-uniformity in both  
2 stretched and relaxed states.

3 Another aspect of the present invention is to provide a method for making said  
4 color-fast material.

5 These and other aspects of the present invention will become apparent to those  
6 skilled in the art after a reading of the following description of the preferred embodiment  
7 when considered with the drawings.

#### 8 Brief Description of the Drawings

9 Figure 1 is a knitting pattern for a preferred embodiment according to the present  
10 invention.

11 Figure 2 is a knitting pattern of an alternative embodiment of the present invention.

#### 12 Detailed Description of the Preferred Embodiments

13 In the following description, like reference characters designate like or  
14 corresponding parts throughout the several views. Also in the following description, it is  
15 to be understood that such terms as "forward," "rearward," "front," "back," "right,"  
16 "left," "upwardly," "downwardly," and the like are words of convenience and are not to  
17 be construed as limiting terms. Also, referring to the drawings in general, the illustrations  
18 are for the purpose of describing a preferred embodiment of the invention and are not  
19 intended to limit the invention thereto.

20 The present invention includes a color-fast material having a combination of a  
21 first component with substantial stretch or elastomeric properties and a second  
22 component with substantially lower stretch or elastomeric properties than those of the  
23 first component, or even substantially non- elastomeric properties, wherein the material is

1 a fabric manufactured by knitting, weaving, non-woven or other fabric manufacturing  
2 process and at least one component, preferably the second substantially lower stretch  
3 material is dyed prior to fabric formation for providing a material having a color-fastness  
4 and color-uniformity in both stretched and relaxed states and method of making said  
5 color-fast material.

6 In a preferred embodiment of the present invention, the first component is a  
7 stretch component such as a SPANDEX, typified by the commercially available LYCRA  
8 supplied by DuPont, and the second component does not include an elastomeric  
9 SPANDEX or similar yarn material. The spandex yarn component may be solution dyed  
10 during the spinning process, or a natural non-colored clear, bright, or dull luster. While  
11 the second component is referred to as non-stretch, it is considered so with respect to the  
12 first component and as will be recognized and understood by one of ordinary skill in the  
13 art that most textile yarn components have some measurable degree of stretch, normally  
14 described as elongation and expressed as a percentage of increase of the fiber length over  
15 it's original relaxed measured length, even without including a stretch-specific or  
16 elastomeric material such as spandex. Preferably, the second component is a synthetic  
17 component selected from the group consisting of nylon, polyester, olefin, rayon, acrylic,  
18 modacrylic, acetate, triacetate, and the like, and combinations or varieties thereof, the  
19 synthetic component being substantially non-elastomeric when compared with the first  
20 component's properties. Other synthetic yarns may also be used. Alternatively, natural  
21 fibers and yarns may be employed as the second yarn component, including but not  
22 limited to cotton, wool, silk, cashmere, or other vegetable cellulosic or protein animal  
23 hair fibers , and the like, and combinations thereof. Preferably, the fabric of the present

1 invention uses one or more from a combination of solution dyed thermal heat settable  
2 synthetic continuous filament yarns selected from a group consisting of Polyamide  
3 (Nylon), Polyester, Olefin (Polypropylene), Spandex, or the like as a prime ingredients  
4 for the fabrics. Alternatively, 100% same yarn non-elastic fabrics, as well as preferred  
5 embodiments such as fabric yarn combinations of solution dyed Spandex with solution  
6 dyed nylon or polyester.

7 A method of making the color-fast material according to the present invention  
8 includes the steps of providing a first yarn component and a second yarn component for  
9 inclusion in a fabric; treating the yarn components separately, such as by solution dyeing  
10 during the fiber spinning process at least one of the yarn components; fabricating a  
11 material from the yarn components. Additional steps may also preferably be included in  
12 the present invention, depending upon the material's end uses, such steps including but  
13 not limited to scouring the fabric; treating the fabric, such as with a finish for enhanced  
14 fabric performance, including anti-microbial, stain resistant, water resistant, water  
15 repellant, wicking agents and/or treatments, and combinations thereof. Further fabric  
16 processing including garment manufacturing may also be included.

17 Preferably, products using the fabric made according to the present invention are  
18 suited for a variety of applications, including but not limited to active wear, athletic wear,  
19 fitness wear, fashion swimwear, competition swimwear, intimate apparel, and such  
20 garment applications requiring fabric with superior aesthetics, superior and durable color  
21 retention through robust multiple cleaning and laundering cycles, and outstanding  
22 uniformity and consistency of colors repeating from lot to lot throughout manufacturing  
23 over time. More particularly, in a preferred embodiment, the fabric made according to

1 the present invention is warp- or weft-knitted superior performance fabric, including a  
2 stretch or elastomeric and a substantially non-elastomeric components having color-  
3 fastness for both components such that when the fabric is stretched, the color properties  
4 of the overall fabric do not exhibit substantial differences between the components as  
5 compared to the relaxed, non-stretched fabric state.

6 Also, preferably the present invention further includes specification knitted  
7 fabrics containing such unique performance properties as anti-bacterial, hydrophyllic/  
8 hydrophobic moisture maintenance functions/systems, enhanced chlorine resistance, and  
9 quick drying properties. Such specification fabrics are preferably provided for  
10 applications where superior performance stretch fabrics are designed and employed for  
11 active wear, athletic wear, fitness wear, competition swimwear, intimate apparel, and  
12 such garment applications requiring fabric with superior aesthetics, superior and durable  
13 color retention through robust multiple cleaning and laundering cycles, and outstanding  
14 uniformity and consistency of colors repeating from lot to lot throughout manufacturing  
15 over time. In particular, in the case of competition swimwear, the fabric is typically  
16 exposed to chlorine on a daily basis, in its use in chlorinated swimming pools and  
17 repeated cleaning thereafter, where such rigorous treatment may also require a chlorine-  
18 resistant spandex, in addition to the processing according to the present invention,

19 In particular, the present invention provides for warp knitted and weft knitted  
20 fabrics with better locked-in color consistency from lot to lot through manufacturing and  
21 the life of the garment than standard commercial state of the art fabrics previously  
22 available in the marketplace. Such types of stretch knitted fabrics, which are typically  
23 engineered for specific end-use garment applications while providing superior



1 performance and garment care cleaning properties, and/or engineered for performance  
2 specifications using special yarn, fabric construction, and manufacturing process with  
3 minimal variation between lots, are particularly well-suited applications for the fabric  
4 manufactured according to the present invention.

5       Thus, the present invention provides a method of making fabrics with a process  
6 that essentially eliminates many of the normal textile related variables associated with the  
7 wet process of dyeing and applying color to the raw materials used while simultaneously  
8 accomplishes the specification fabric manufacturing in a minimum number of steps.  
9 Furthermore, the method of making stretch or non-elastic fabrics according to the present  
10 invention avoids using environmentally unfriendly dyestuffs and chemicals such as those  
11 applied in a wet dyeing process, and simultaneously requires much less energy  
12 consumption within the process than standard state of the art fabric making commercial  
13 practices.

14       In another embodiment according to the present invention, the elastomeric or  
15 stretch yarn component, preferably spandex, is solution dyed. While in many cases the  
16 solution dyed spandex is provided in colors to match the non-elastomeric yarn  
17 component, in particular a synthetic yarn component that is also solution dyed, the  
18 present invention includes a solution dyed elastomeric yarn, in particular solution dyed  
19 spandex that is dyed in a predetermined shade selected from dark shades including black,  
20 gray, and navy, such that the solution dyed spandex does not precisely match the solution  
21 dyed non-elastomeric yarn. While prior art typically strives for matching yarns  
22 coloration and/or shading, the present invention provides for solution-dyed yarn  
23 components that retain their coloration better over time, but wherein components within

1 the fabric having different properties, i.e., elastomeric versus non-elastomeric, are  
2 intended to have slightly different coloration such that the visual effect of the finished  
3 fabric appears to be substantially the same or similar coloration when in either a relaxed  
4 or non-stretch state when compared with a stretched state. As such, the present invention  
5 provides for the fabric in a relaxed state to have the appearance of a consistent color  
6 throughout the fabric, as well as in a stretched state, even though the yarn components are  
7 not intended to match as closely as possible. This provides for better consistency from  
8 lot-to-lot for each of the solution dyed yarn components and commercially in finished  
9 products as set forth hereinabove after garment use, wear, and cleanings, due to the fabric  
10 using solution-dyed yarns.

11 In yet another alternative embodiment according to the present invention, a non-  
12 solution-dyed spandex may be used as the elastomeric component. Such spandex  
13 component is provided in clear, bright, and/or dull finishes, and subsequently dyed in a  
14 less hostile, below-the-boil dyeing process, where by contrast, the non-elastomeric yarn is  
15 solution-dyed.

#### 16 Design Example(s)

17 This section outlines a few design examples, not necessarily optimized, but illustrative of  
18 what can be done for a fabric formed according to the present invention as set forth in the  
19 foregoing. These design examples include:

##### 20 *Example 1*

21 In this preferred embodiment of the fabric as set forth in the foregoing, as shown in  
22 Figure 1, illustrates a knitting pattern for a 2-bar warp knit tricot jersey fabric wherein the  
23 front bar is solid threaded with solution dyed synthetic continuous multifilament or

1 monofilament yarn 69. The back bar is solid threaded with solution dyed SPANDEX  
2 elastomeric yarn 70.

3 *Example 2*

4 In this preferred embodiment of the fabric as set forth in the foregoing, as shown in  
5 Figure 2, illustrates a knitting pattern for a weft-knit single jersey fabric with all feeds  
6 knitting on all needles of the cylinder. A solution dyed synthetic continuous  
7 multifilament yarn 60 is plaited along with a solution dyed spandex elastomeric yarn 58  
8 in all feeds. As depicted, six feeds are shown in FIG. 2 for the purpose of illustration only  
9 as it will be understood by those skilled in the art that the number of yarn feeds and their  
10 knit instruction according to the knitting sequence will be dependant upon the individual  
11 circular weft knit machine and the diameter of the cylinder relative to the number of yarn  
12 feed positions that are appropriate for a specific machine circumference and the number  
13 of different feeds required to complete the knitting construction sequence that will repeat  
14 evenly about the circumference of the cylinder accordingly.

15 Certain modifications and improvements will occur to those skilled in the art upon  
16 a reading of the foregoing description. By way of example, a fabric may contain a  
17 solution dyed spandex yarn ingredient and solution dyed nylon or polyester yarn  
18 ingredients plus a third un-dyed yarn ingredient that can be colored in fabric form by  
19 over-dyeing, thereby simplifying the dyeing process thus minimizing the number of steps  
20 in the total fabric coloration process, as well as the number of stock keeping units  
21 associated with multiple colorations of fabric being tracked in the particular fabric style  
22 inventory All modifications and improvements have been deleted herein for the sake of  
23 conciseness and readability but are properly within the scope of the following claims.